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NORTHEASTERN FOREST EXPERIMENT STATION

In Cooperation with Yale University

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PROBLEMS AND PROGRAM
of the
NORTHEASTERN FOREST EXPERIMENT STATION
(Annual Report of the Director for 1937)

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PROBLEMS AND PROGRAM
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THE REGION

Forestry is at a Relatively Advanced Stage in the Northeast

The territory served by the Northeastern Forest Experiment Station, comprising all of New England and New York, is one of peculiar interest and significance with respect to forestry. In spite of more than two hundred years of intensive exploitation, the forests of the Northeast continue to make an important contribution to the economic life of the region. Having been subjected to the pressure of the country's greatest population density since colonial times--a pressure first expressed in the need for more cleared land for agriculture, then in successive waves of industrial utilization all too frequently accompanied by destructive fires, and more recently in the spread of suburban residential developments--the forests still occupy more than half of the land area. They are receiving more and more attention in recognition of their functions in ministering to the needs of the people for outdoor recreation, in providing cover and food for wildlife, in the protection of municipal water supplies, in minimizing floods, and in building soil, as well as in providing raw material for industry and fuel and cash income to farmers. Agencies concerned with planning for the use of land and for social and economic development are realizing more and more the importance of the forest resource and the extent to which the region must look to the forests and industries dependent upon the forest for support of the rural population.

The effects of the long cycle of forest exploitation in the Northeast may serve as an object lesson to guide developments in the newer sections. At the same time this region points the way for other sections of the country in both state and private forestry activity. Because of its dense population and relatively long economic history, public appreciation of forestry is perhaps further developed in this region than in any other.

Decades of widespread public education in forestry have developed an informed public opinion which calls for a departure from the generalities formerly sufficing and demands solution of the many specific problems encountered in actual forestry practice. The problem here is not one of retaining land in forest, but of how to make forest land productive and how to correlate recreation, wildlife, timber production, and watershed protection. Rather than argue that the forest is a crop, the demand is increasingly for information on how the crop should be handled. With fire protection generally established and increasing in effectiveness, the need is now for better protection from insects and disease. Furthermore, the water problem in this region is beginning to be recognized not so much as one of reforestation as of the character of the forest cover, which in turn is intimately related to the intensity of forest management.

All in all, the Northeast is past the stage where elementary, superficial, technical information will meet the need. Only by thoroughgoing research dealing with economic as well as technical aspects of the problems in hand can real progress be made.

Another noteworthy aspect of the situation here is that the forty million acres of forest land, all within a few hundred miles of the large centers of industrial development, present such a wide range of conditions, both natural and economic. On the one hand, there are over eleven million acres of farm woodlands while, on the other, an almost unbroken wilderness of about ten million acres still remains in northern Maine. Economically, the region may be considered in three zones which are rather closely related to, although not coextensive with, the four major forest types of the region.

The Sparsely-settled Wild Lands

The sparsely-settled wild lands of northern New England and New York present an entirely different set of problems than does the rest of the region. This zone corresponds roughly to the spruce-northern hardwoods type. It contains the bulk of the merchantable timber supply in the Northeast, but must compete with water shipments from the South, the Pacific Northwest, Nova Scotia, and Newfoundland in the consuming markets of the industrial and urban centers along the coast.

Although white pine was originally a very important element, the forests of this zone are now composed primarily of yellow and paper birch, beech, and sugar maple, intermingled with red spruce and balsam fir. In recent years the production of softwood lumber has given way almost entirely to the cutting of pulpwood. Because of lack of transportation facilities, hardwoods have had practically no market throughout much of the region, especially in Maine. However, in Vermont and portions of Maine, New Hampshire, and New York, where the original growth of spruce has been largely exhausted and where roads have been developed, a number of hardwood industries assume major importance.

Ownership of the land in this northern forest zone differs from conditions elsewhere in the Northeast in that relatively large areas are controlled by a few paper companies or estates, individual holdings frequently running into hundreds of thousands of acres and in one case as high as two million acres. In this zone are also found the major units of public ownership in the Northeast; namely, the White and Green Mountain National Forests and the Adirondack Forest Preserve in New York. Forestry in this region will be largely of an extensive character and will be concerned with problems of industrial management and public ownership.

The Densely Populated Industrial Zone

At the other extreme is a zone immediately adjacent to the industrial and residential centers comprising most of Massachusetts east of the Connecticut River, all of Connecticut and Rhode Island, and the southeastern portion of New York. This zone corresponds roughly with the limits of the oak type in this region. Chestnut was formerly the most widespread and commercially valuable tree in this zone, but since its elimination by the blight the several species of oak have assumed a larger importance. Hemlock is the most important conifer in most of the zone, but northern white pine is abundant in much of Massachusetts.

The rapid development of agriculture in this zone led to early and very extensive clearing of land prior to the opening up of the West. Subsequent economic changes resulted in widespread abandonment of the poorer and rougher lands during the past century, and extensive areas have reverted to forest growth which, however, has frequently not been of desirable character. Furthermore, because of extreme accessibility the forests have been repeatedly combed for merchantable timber, clear-cutting by portable mills and stripping for fuelwood becoming the general practice in recent decades. Finally, this zone is subject to a period of severe fire hazard each spring, and prior to the development of systematic protection in recent years little of the area escaped some damage from fire. Even now repeated fires are responsible for the scrubby character of the forest growth in many sections, especially in Rhode Island and southeastern Massachusetts. As a result of the vicissitudes of the past, although more than half the land area must be classed as "forest," the growing stock or stand of usable timber has been reduced to the vanishing point throughout a large part of this zone and there is scant basis for much industrial development.

However, with the ever increasing use of automobiles and the improvement of highways and country roads there has been a steady spread of suburban residential development and increasing migration of city people to the country. Proximity to urban centers or prospects of sale to city people for summer residence has raised land values in much of this zone to a relatively high level, thus creating a paradoxical situation in which the land is stripped and left non-productive because it is worth too much for timber production. Correlative to the increasing mobility of the city population is rapid extension of the size and number of parks, parkways, and other recreational areas. Another factor of importance in this zone is the need to provide water for the urban centers. Competition between communities for available supplies presents complex questions of land use planning. Protection of municipal watersheds offers perhaps the best opportunity for forestry practice in this zone.

The Farm Woodland Areas

The third zone, which may be described as intermediate between the other two both geographically and economically, corresponds roughly to the white pine and Allegheny hardwood types. Forests characterized by the predominance of white pine occur from southwestern Maine, through southern New Hampshire, much of central and eastern Massachusetts (which has been included in the densely populated, industrial zone), to the Connecticut River valley along which it extends well up into the northern forest. The Champlain basin and the plains of the lower Mohawk and upper Hudson are also designated as part of the white pine type. On the lighter soils of this type white pine has succeeded in reproducing itself through successive waves of exploitation. On the heavier soils there is a tendency for pine to alternate with hardwoods, among which oak and red maple are the most abundant. In the northern sections, however, yellow birch, beech, and sugar maple are the important elements in mixture.

The history of the white pine type has been very similar to that of the oak type. Extensively cleared for agriculture in early years, later allowed to revert to forest and subjected to repeated cutting, the growth now is generally of small size and inferior quality. However, the prevalence of pure stands of second growth pine on old fields and the ready market for such low grade products as box boards have served to maintain a substantial lumber industry right up to the present. Failure of white pine reproduction following clear-cutting of these old field stands presages a dwindling of activity in the forest industries in the years immediately ahead.

The Allegheny hardwood types, which in this region may be considered along with the white pine type, occupies that part of New York State lying between the Pennsylvania line on the south and the Ontario plains and the Mohawk valley on the north. White pine was originally very generally distributed, but is now of only minor importance. Hemlock still supplies about half of the annual lumber cut, although this species has also been rather extensively exploited. Yellow birch, beech, and sugar maple are the most common and important species. Basswood, black cherry, white ash, and red oak also occur in mixture and generally command excellent prices.

The history of this type is not as long as in the case of the white pine and oak types, but it has followed similar lines. Although scarcely settled at all prior to the opening of the nineteenth century, it is surprising to find that the peak of population in much of this section was reached around 1830. Abandonment of sub-marginal agricultural land, largely completed in New England, is still an important factor in land use adjustment here. In this the State is taking an active part through its huge reforestation program. Because the process of repeated cutting of the woodlands has not progressed so far in this type as in central and southern New England, forest growing stock is in much more satisfactory condition and woodland owners have better opportunity to organize for sustained yield management.

The zone consisting of the white pine and Allegheny hardwood types together is characterized by a well distributed rural population, numerous small cities, and a variety of wood-using industries. The zone is well served by a network of improved highways and town roads, as well as by numerous railroad lines. It supports a substantial and permanent agriculture primarily dependent upon dairying. Ownership is largely broken up among small holdings, and forest land is generally intermingled with agricultural areas. In the Allegheny hardwood type woodland constitutes only about 25 percent of the land area, but in the white pine section of New England the forest occupies considerably more than half the total area. This zone may perhaps be best described as the farm woodland area of the Northeast. From an economic point of view it is benefiting to a considerable extent, especially in New England, from the increasingly large number of city people who are buying up old farms for summer residences.

The contrast in forest conditions between the northern and southern sections of the region is further brought out by consideration of the stage of development of the forest growth. Only one-fifth of the forest area in the densely-settled industrial zone and one-fourth of the farm woodland areas support timber of sawtimber size, whereas in the sparsely-settled wild lands to the north more than two-thirds of the area is so classified. On the other hand, from 40 to 50 percent of the two southern zones supports nothing more than reproduction or brush, but less than one-fifth of the wild land zone is currently in this condition.

MAJOR PROBLEMS FOR RESEARCH

Feasibility and Place of Selective Cutting and Integrated Utilization in Restoring and Improving Forest Growing Stocks

The most fundamental forest problem throughout the Northeast is to restore and improve forest growing stocks so as to provide a sound basis for profitable sustained yield management and at the same time conserve watershed, wildlife, and aesthetic values. The problem exists even in the wild land zone because much of the area classified as sawtimber in the spruce-northern hardwood types is understocked and because so much of the timber present consists of poorly formed or defective residual trees in repeatedly-culled old growth forests.

Timber of large size and high quality has always been in demand at good prices; in fact, in the early days only the very best timber could be sold. The use of wood for charcoal and distillation products is the only significant exception to this. The growing demand for chestnut and oak for railroad ties in the decades following the Civil War lowered earlier standards of profitable utilization for these hardwoods. Similarly, heavy demands for box boards to provide shipping containers for New England's many industrial products, which reached a peak early in the present century, made possible the wholesale utilization of the inferior second growth white pine; and the rise of the pulp and paper industry paved the way for extensive clear-cutting in the

northern spruce types. Each new form of utilization and each technological advance in the manufacture of forest products, applied without regard for conservation of growing stock or permanence of raw material supply, has carried forest depletion to a more advanced stage , provided only transient prosperity, caused some loss in earlier industry, and raised more critical problems of sustaining the industries which remain.

The welfare of the forest industries is very directly dependent upon proper management of the forests and particularly upon the maintenance of a growing stock containing a substantial proportion of high quality timber of relatively large size. No matter how much land there may be in forest or how great the annual growth of wood material may be, it can not have an economic value unless it can be realized in trees of merchantable size; and growth on stems of size suitable for the manufacture of high quality products is far more valuable than the same amount of growth dissipated on saplings and brush which can never be utilized.

The oft cited theory that with new methods of chemical utilization the harvesting of forest crops on very short rotations will supplant traditional sawtimber production is largely a will-o'-the-wisp. It has been repeatedly shown that costs of handling forest material mount very rapidly as the average size of the stems decrease. Furthermore, the converting industries have never been able to pay a price for their raw material comparable to that commanded by high quality sawtimber. There is no indication that this situation will change. On the contrary, there is abundant support for the belief that the interest of public and landowners alike will be best served by a forest management program based on an integration of use, in which high quality sawlogs are the primary objective while pulpwood, small dimension stock, and other forms of utilization take that part of the forest crop which does not meet the requirements of the more exacting products. Such integrated utilization would be most conducive to sustained yield and could be accomplished through a succession of partial cuttings repeated at frequent intervals rather than by clear-cutting which offers no prospect of further income from the land for a century.

To provide an economic and technical foundation for such selective cutting and for the building up of forest growing stock is the broad objective of much silvicultural, economic, and forest products research in this region. The objective may be attained by developing appropriate forest practices, determining the best basis for organizing timber harvesting operations for sustained yield, and studying methods of improving the channels of trade through which forest products reach the consumer.

Utilization of Surplus of Small and Low Grade Material: A Major Problem in the Densely Settled Industrial Zone

Because depletion of forest growing stock has already advanced so far in much of the northeastern territory, a program of sustained industrial activity such as has been outlined above hinges to a large extent upon the development of outlets for the huge quantities of small and low grade material which will have to be taken from present stands in the process of forest restoration. It is believed that in the Northeast there is currently a substantial excess of annual growth over commercial use. Although the accumulation of current surpluses of growth over cut is the only way in which forest growing stocks can be built up, a large part of the current surplus is not in trees of species, size, or character in demand by the lumber and other primary wood-using industries. The surplus includes much by-product material in the form of residual trees in cull-old growth stands, trees to be removed in thinning or improvement of second growth stands, and material of inferior species or form coming in on abandoned farms, lands, or areas recently clear-cut. Such material needs to be removed currently if forest values are to be restored. Without profitable outlets for such material there is little hope of checking the cumulative deterioration of forests in the industrial and farm woodland zones or of maintaining the limited industrial activity which they still support.

Wider use of hardwoods for pulp, commercial development of new plastic made from wood, fermentation of cellulose to produce ethyl alcohol and other chemical products, broadening the market for charcoal to permit expansion of the wood distillation industry and the use of wood gas for internal combustion engines, or for fuel in rural communities and certain industrial processes such as the annealing of brass and the baking of brick, are some of the possibilities to be explored. Stimulation of a return to the use of wood for fuel, especially in rural communities, is perhaps as important as any new uses which may be developed. This involves modification in methods of handling fuel wood to reduce its cost to the consumer and improvement in equipment for burning to increase its efficiency and convenience in use.

The problem of utilization of small and low grade material is of particular importance in the densely settled industrial zone and in the farm woodland sections, especially those in New England.

Improvement of Logging Methods, Equipment, and Organization: A Problem of Industrial Forestry in the Sparsely-settled Wild Lands

For the sparsely-settled wild lands of the spruce and northern hardwood forest, selective cutting and sustained yield management are intimately related to the development of roads for truck transportation and the improvement of operating practices. Organization of forest enterprises in this region has remained remarkably static for generations. The only major changes have been those associated with the transition from cutting of long logs for lumber to 4-foot wood for pulp. If sawlogs again become the primary objective of management, as we believe they should, and if integrated utilization gains any acceptance in the zone, practices adapted to the exclusive handling of 4-foot wood will have to be drastically revised.

Hauling over ice roads on sleds in the winter and driving of the streams have been the only methods of logging in much of the region. Besides involving considerable uncertainty as to the costs of operation each year and requiring working under abnormal pressure when seasonal conditions are right, this system restricts the species which can be taken out to those which float, and involves difficult problems in providing food and supplies for men and animals on the operations. The relative inaccessibility of camps under this system makes effective supervision from headquarters very difficult and discourages the use of new ideas in equipment and method.

The effects of this system extend far beyond the logging operation itself. It involves important social problems in respect to woods labor , tending to perpetuate a transient, homeless element, and discouraging permanent community life. It encourages clear-cutting of all merchantable timber and limits the opportunity for intensive forest management. It makes protection from fire, insects, and disease difficult, and often renders hopeless the salvage of killed timber.

This situation makes it increasingly difficult for forest owners and operators in this region to produce timber in competition with that from more distant regions or from other countries, and tends to jeopardize the existence of important industries and reduce opportunities for gainful employment.

Effective planning of timber-harvesting operations would be greatly facilitated by studies of such matters as the proper balance between road construction to keep grades down and increased costs involved in hauling over excessive grade, effective skidding distance under varying conditions of slope and size of timber, the possibilities in the use of portable chutes and power saws for pulpwood, and of tractors for skidding and hauling. Zoning of the forests in terms of economic accessibility, determining the intensity of management applicable in each such zone, planning transportation systems, and adapting operating methods to selective cutting are other difficult problems facing timberland owners interested in sustained yield management in the wild lands of the North.

Organization of Production to Improve the Channel of Trade from Stump to Market: An Answer to the Farm Woodland Problem

In the farm woodland areas because the timber is so generally accessible, occurring in relatively small tracts, interspersed with open land and well served with permanent roads, operating problems do not assume the importance they have in the sparsely-settled wild lands. On the other hand, utilization is only one phase of the problem, perhaps secondary in importance as compared to the densely settled industrial zone because, although generally rather badly run-down, northeastern farm woodlands do contain some material of size and quality to meet a wide variety of exacting demands, and they are capable of producing much more material of much better quality. For the farm woodlands marketing difficulties present the most serious problem. The small owners are unable individually to look up possible outlets for their forest products other than those which present themselves locally. The result is that farm woodlands are frequently cut for fuelwood or sold to the portable mill operator who rarely is able to pay full value for the timber and generally converts the entire stand into a single product with little effort to utilize waste. The tendency is to cut clear as soon as the timber reaches a size where some material is marketable, and in many cases this means converting into fuel wood or low grade construction lumber young, thrifty trees of valuable species just reaching a size where most rapid growth of high quality material is being put on. In other cases, the owner has opportunity to sell to specialized consuming industries, but these generally afford him an outlet for only the higher grade material which constitutes but a small proportion of what he has to sell and leaves his lot in possession of the less valuable species and least desirable trees which often may not be profitably operated alone.

In the farm woodland areas, cooperative organization holds much promise of creating conditions conducive to stable industrial development and sound forest management. Through cooperative organization the relatively small quantities of timber cut each year from individual farms under the principle of light selective cutting at frequent intervals can be accumulated into a sufficient volume to justify sorting and grading to effectively enter the markets for the diversified products which must be sold.

But in most situations the advantages of cooperative organization will not be fully realized unless the producers control their own processing facilities. The present unsatisfactory situation with regard to farm woodlands is attributed in large measure to the lack of adequate facilities for processing the material to meet competition from other regions. Only through control of the primary manufacturing facilities can industrial production in any locality be geared to the needs of the woodland owners. This is an element in the economic picture which has not been operating in the past. Industry has been primarily concerned with obtaining maximum profit from the manufacturing process and has been unmindful of whether or not an adequate return was provided for the timber grower. Substantial improvement in existing channels of trade may be expected through a program of cooperative forest management and utilization including all operations from forestry practice to marketing of processed material to lumber dealers, fabricating plants, or other consuming industries.

Progress toward the major objective of sustained yield management through any of the channels suggested above is handicapped by lack of basic knowledge of the status of the forest resources and prospective demand for forest products, and by uncertainty with respect to the reaction of numerous economic factors upon any long-range forestry enterprise. The place of forestry in the economic life of the region can only be properly evaluated by a comprehensive survey of forest resources to determine for each state and for smaller economic units the quantity, quality, and location of existing supplies, the present and potential growth, the rate of depletion and consumption, and the trend in the utilization of forest products. Such information when correlated with results of the national forest survey in other sections of the country is essential for determining sustained yield capacities and for long-range planning aimed at industrial and community stability.

Analysis of the present and potential place of woodlands in rural economy would be of especial advantage in stimulating better management of farm woodlands. Forestry is now generally recognized as an integral part of the farm business in the Northeast. But there is little information on the contribution which the woodlands are now making, of the opportunities for their more effective management, or of the indirect social benefits which may be derived from them. By stabilizing the opportunity for employment, building up the productive capacity of neglected stands, and providing supplementary cash income, forestry may fundamentally affect the margin of profit in agriculture, the stability of population, the revenue from local taxation, the maintenance of roads and schools, and almost every other aspect of rural life.

Inequitable taxation is commonly held as a major handicap to sustained yield forest management. In some sections annual taxation of forests at essentially full market value practically forces an owner to cut his timber as soon as it reaches salable size. Although the solution of the forest taxation problem must be worked out as an integral part of the whole scheme of taxation in a way which will bring relief to all forms of rural property, the present difficulty may be minimized and the burden rendered less onerous to the extent that selective cutting can be put into effect and adequate growing stocks maintained to produce regular income to meet the annual charges.

The risk of loss from fire, insects, and disease, as well as the difficulty in obtaining credit to finance forestry operations, offers other handicaps in the current situation. Inauguration of commercial forest insurance, for which the way has been paved by Forest Service studies in this region and the Pacific Northwest, will eliminate one of these sources of uncertainty.

While a federal agency to finance forestry operations would be of inestimable value, the handicap which forest properties now face in the field of commercial credit might be largely eliminated if there were general recognition of the sustained yield principle and if ready markets for forest property could be developed. Salability is an important consideration in property pledged as collateral for a bank loan. Without public appreciation of the investment value of properly managed forest property, salability is lacking.

It will be seen that all these factors are interrelated so that progress can best be made by attack on a broad front. Improvement of forest practices and building up of growing stock will facilitate solution of the underlying economic problems, and conversely considerable impetus to sound forest management will result from amelioration of adverse or uncertain economic influences.

The Influence of Forest Cover on Streamflow and Water Supply

The problem of adequate supplies of suitable water for the industrial sections of the Northeast is one whose importance can not be over-emphasized. In fact, water is likely to be the limiting factor in future community development in much of this region. Quality of the water may be of as much importance as quantity and regularity of flow. Turbidity, for example, not only involves cash expense for chemical treatment, but may affect adversely a number of industries requiring pure water for technical purposes.

Recurrence of disastrous floods on many streams in the Northeast indicates the need for thorough study of watershed conditions to locate critical areas and to determine what measures of control or adjustments of land use may be desirable to minimize danger from abnormally high water. Stability of streamflow is a matter of importance also in connection with the many installed and potential power developments, as well as for maintenance of optimum conditions in fishing streams and at inland water recreational areas.

Preliminary consideration of some of these problems indicates the need for coming to grips with detailed relationships rather than broad generalities. The kind of forest, its stage of development, and the way it is managed all appear to have a significant influence on the water problem in one way or another. Evidence is accumulating to show that the character and structure of forest soils, and hence their permeability, are definitely influenced by the character and composition of the forest they support, this influence being expressed in part through an abundant but inconspicuous fauna inhabiting the soil itself. Penetration of frost and accumulation and retention of snow are other factors affecting floods and water supplies which need detailed analysis to determine how they are influenced by variations in forest cover.

Although the work of the Northeastern Forest Experiment Station is aimed at the basic problems outlined above within the limitations of current finances, consideration of the work under way in relation to this broad view of the region and its problems brings out clearly the inadequacy of the present program and indicates the fields in which it needs strengthening.

Forest Economics

Cooperative Management and Utilization for Farm Woodlands

In an effort to meet the farm woodland problem outlined in a preceding section, the Station has under way a project dealing with cooperative management and utilization at Cooperstown, New York. Based on preliminary studies of the local situation by the experiment station and sponsored by the Cooperstown Chamber of Commerce, woodland owners in the vicinity organized the Otsego Forest Products Cooperative Association, Inc. Starting with a small interested group, this Association had 232 members with a forest area of about 10,000 acres by the time woods operations got under way in the fall of 1937.

Common stock in the cooperative association can be acquired only by those engaged in producing forest products. After an initial subscription it is issued in part payment for products delivered to the Association under a revolving plan which will keep control in the hands of active producers and at the same time provide flexibility of capital. Each member has only one vote no matter how much stock he may own. Authorized capital, in shares of $1 each, consists of $50,000 in common stock and a like amount in preferred stock which may be issued to anyone, but carries no vote. About 4,000 shares of preferred stock have been purchased, mostly by citizens of Cooperstown. Members must agree to sell all their forest products, except fuel wood, through the Association and to manage their woodland according to sound forestry principles set up by the Association.

As a basis for the system of forest management adopted by the Association, the experiment station has made an anlysis of the forest resources on the individual properties of most of the members. In this work a new, rapid, and cheap system of farm mapping and woodland inventory has been evolved which should have wide application in sustained yield management projects in all sections where the country is subdivided into small irregular ownerships. It is estimated that the total cost of forestry control provided by this system, including marking of trees to be cut, will be from 8 to 10 cents per cord. The system of marking being applied aims to improve the quality and growth rate of the stand by light selective cuttings, taking trees of low vigor or poor quality in all size classes. The amount designated for removal at any one time is equivalent to the growth of only 3 to 5 years. Under this system it is evident that a relatively large acreage, involving a correspondingly large number of owners, must participate in the cut each year in order to obtain a given volume of product. For the current season logging contracts have been arranged with 124 members. These contracts involve about 922,000 board feet of sawlogs which is about all that can be handled by the temporary mill now in operation. From two to three times this amount should be handled when the Association's new mill is in operation.

To provide capital for initial operations and to finance the construction of an efficient processing plant especially designed to handle the varied classes of material yielded by the woodlands of the members, the Association has obtained a loan of $100,000 from the Farm Security Administration. Responsibility for technical supervision of this loan has been placed in the Forest Service, and the Association has sought the guidance and advice of the experiment station in every phase of its activities. Labor policy, purchase policy, accounting practice, plant design, log grading and prices, forestry methods, and a program of membership education have all been largely developed for the Association by the station.

A general study of the industrial markets for wood within thirty miles of Cooperstown shows the possibilities of handling a substantial volume and a wide variety of products nearby. A special study of the use of wooden crates used in the fruit and vegetable industries of New York State indicates the possibility of moving some low grade material in this form. The most significant feature of this project is that it attacks the farm woodland problem simultaneously on all fronts. Advice and guidance in the management of the woodland is integrated with improvement of facilities for converting the products into most salable form and analysis of available markets. Technical practices, operating methods, and management problems are all being subject to study so that it should be possible to evaluate the results in a more satisfactory way than if attention were restricted to any one phase of the problem.

Forest Insurance

The study of forest fire insurance, first undertaken in the Pacific Northwest, has been completed in the Northeast. Field work in this region included the states of Maine, New Hampshire, Vermont, Massachusetts, New York, and Pennsylvania. The study shows that there is ample opportunity for entirely practical forest fire insurance in this region as is the case in the Pacific Northwest. The results of the northeastern study will be presented in a report suggesting a single rating schedule for the entire region. Considerable time during the past year was devoted to a preliminary canvass of the principal timberland owners both in the Pacific Northwest and the Northeast, and to contacts with representatives of commercial insurance companies in order to bring both sides to the point where forest fire insurance may become a reality. Initiation of this line of insurance will involve organization of an underwriting pool and offering of business simultaneously in the East and the West.

Production Cost Studies

An important aspect of the broad problem of improving forest growing stocks through selective cutting is revealed through analyses of costs of producing lumber and other products from trees of different sizes and through study of the effect of selective or partial cuttings upon operating costs. Results of analyses of six northern white pine lumber operations, conducted in cooperation with the Forest Products Laboratory, have been reported previously. Work of the Northeastern Station on farm pulpwood operations in second growth spruce and fir was also summarized in the Annual Report for 1936.

Three northern hardwood lumber operations have also been studied with the Forest Products Laboratory. The cuttings were all made on a commercial selection basis, utilizing all material that they thought would yield a profit and giving little or no consideration to subsequent productivity.

This study indicated that hardwood operators ordinarily lost money in manufacturing lumber from trees less than 14" in diameter. In addition to determining the minimum sizes that could be profitably handled, the data emphasized the important relationship between tree size, lumber values, and the margin for profit or loss. With an increase in tree size, the operating costs decreased while the value of the lumber increased. The trend in operating costs was slightly upward in the case of extremely large trees, but the relatively slight increase in costs was more than offset by the higher proportion of lumber in the upper grades. On the three operations the spread between production costs and graded lumber values was from $15 to $25 per thousand more for the largest than for the minimum tree sizes. Furthermore, it appears that operators do much better when edging and selling graded lumber than when selling round-edged lumber on a mill run basis.

Sample plots established in each locality provide an opportunity to follow the subsequent development of the stands after these typical commercial logging operations. These areas will serve as a basis for comparison when studies are made in stands of the same type cut under a true silvicultural selection method rather than the commercial "creaming" process.

The analysis of these operations points toward the desirability of a forest management policy which will maintain a well-stocked thrifty stand and provide for the periodic removal of large, financially mature, high quality trees. Although the stands in this study were in a generally decrepit condition and not particularly well suited to a silvicultural selection cutting, the operators could have obtained a better financial result and raised their average profit per thousand by reserving a considerable number of trees in the smaller and intermediate size classes.

During the past year another cooperative project dealing with log grading and log scaling for northern hardwoods was undertaken by the Forest Products Laboratory, the New York State College of Forestry, and Cornell University. This study substantiated the findings of one of the earlier hardwood production cost studies that the International Log Rule gave a greater scale than mills could actually obtain in the manufacture of lumber. It also provided a basis for formulating tentatively a set of log-grading rules based upon a new principle. Difficulty experienced in this study, in finding mills where the bulk of the product was being put into 1" and 2" lumber, led to the conclusion that future work of this sort should be directed at study of economic recovery in different forms and combinations of utilization rather than at the production of lumber alone. The results also point to the advisability of substituting cubic measure for board measure in order to have a unit of more general and uniform applicability.

Forest Management

The work of the Station in the field of forest management has been very largely confined to the types characteristic of the northern part of the region. Work dealing with the white pine types has been almost entirely restricted to carrying a series of permanent sample plots initiated prior to the establishment of the experiment station, and in the oak types attention has been directed chiefly to the analysis of damage from forest fires. However, a limited amount of emergency work has been done in both these forest regions on the problem of silvicultural control of the gypsy moth, and the forest planting investigations have extended into all parts of the station territory.

To a large extent the work in forest management is being concentrated on a series of experimental forests representative of the major forest types and set aside especially for the purpose. Experience has shown that this is a wise policy not only because it safeguards long-time experiments from outside interference, but because it leads to greater efficiency in handling the work and better correlation of different lines of investigation in the same locality. It also permits accumulation of more detailed information concerning the meteorological and ecological conditions under which the experiments are conducted. Six experimental forests are now available for the Northeastern Station, as follows:

1. The Gale River Experimental Forest, of 1,320 acres, in the White Mountain National Forest, New Hampshire, used primarily for studies of the management of spruce and fir.

2. The Bartlett Experimental Forest, of 2,600 acres, in the White Mountain National Forest, New Hampshire, devoted primarily to the management of northern hardwoods.

3. The Massabesic Experimental Forest, of 2,485 acres, at Alfred, York County, Maine, representative of the white pine type.

4. The Hopkins Memorial Experimental Forest, of 1,625 acres, at Williamstown, Massachusetts, in the transition zone between oak and northern hardwood types, being developed primarily for work in forest genetics and the influence of forests on streamflow.

5. The Chenango Experimental Forest, an area of 1,465 acres of state land, near Norwich, New York, devoted chiefly to forest planting investigations.

6. The Finch Pruyn Experimental Forest, an area of 623 acres in the spruce and northern hardwood types, near Newcomb, New York, available by cooperative agreement with Cornell University and Finch Pruyn & Company of Glens Falls, New York.

Management of Spruce Types

When studies in the management of spruce types were first initiated, the principal concern was the development of a silviculture which would successfully regenerate spruce stands. The types of most common occurrence usually support an abundance of advance reproduction. Successful management, therefore, lies mainly in protecting the young growth from logging damage, from subsequent windthrow and fire, and from excessive shading and crowding by hardwoods. However, regeneration of stands with strong admixtures of northern hardwoods, particularly those in which sugar maple and beech predominate, and of dense, even-aged stands of spruce and fir is much less simple. For the latter, a light initial cut removing one-fourth to one-half the stand may be expected to lead to the establishment of softwood reproduction under the shelter of the residual stand. Ten to fifteen years later when reproduction is fully established, the remainder of the old stand may be cut. For mixed stands of spruce and northern hardwoods without an adequate understory of advance reproduction of softwoods, no method of cutting will with any certainty prevent an increased representation of hardwoods in the succeeding stand.

Conditions affecting the establishment of spruce reproduction on cut-over areas have been studied over a period of more than ten years by sowing of definite quantities of tested seed on spots representing the principal variations of the natural seedbed. This study reveals that changed seedbed conditions and dense stands of hardwood sprouts, together with invading brush growth, discourage establishment of spruce and fir following cutting. Where the ground has been broken up and competing vegetation is not too aggressive, the new seedlings may gain a foothold within the first year or two following cutting, but with each passing year conditions become less and less favorable for their establishment.

Attention has also been directed to cultural measures for increasing the growth of spruce and improving the composition and quality of spruce stands. Girdling of defective, overtopping hardwoods has been shown to be effective in stimulating the rate of growth of spruce and has been widely used by both public and private agencies. Experiments have also been undertaken dealing with the technique and results of weeding and poisoning as a means of eliminating undesirable tree species, and of the effects of drainage upon growth in a spruce swamp.

Studies of slash resulting from commercial logging operations show that heavy slash, aside from the fire hazard it represents, forms so dense a cover under certain conditions that it effectually smothers out the advance reproduction beneath it. Slash disposal measures should aim to reduce the density of slash by scattering or burning to a point where it is no longer a deterrent to reproduction. At the request of the White Mountain National Forest an intensive study of slash on areas cut over during the past thirty years in the east branch of the Pemigewasset River valley was undertaken in 1937 in cooperation with the Bureau of Plant Industry. Analysis of the data shows that the decay of spruce slash is correlated with age, aspect, elevation, and steepness of slope. Of the 130 fungi known to attack spruce trees or wood, data have been gathered on the significance of over 100 in respect to the rotting of slash. It appears that softwood slash may constitute an abnormal fire hazard for 8 to 12 years. It is proposed to extend the study next field season to obtain more comprehensive data for final conclusions.

Although spruce is now primarily used for pulpwood in the Northeast, there is reason to believe that it will be in demand for lumber again on an increasing scale as Douglas fir from the Pacific Northwest begins to mount in price with exhaustion of the more accessible stands there. Second growth spruce is generally superior to second growth white pine from the North or second growth yellow pine from the South. Spruce sawtimber will therefore be in very good competitive position. Accordingly, it seems desirable to initiate experiments directed at the management of spruce stands for sawtimber production. Such experiments are in line with the general thesis previously set forth, that best results in forest management may be expected when sawtimber is the primary objective, and when outlets for pulpwood and other products serve to utilize material from thinnings and improvement cuttings and portions of crop trees not suited for sawlogs.

A group of compartments on the Gale River Experimental Forest with stands varying considerably in density, age, and composition are now being devoted to this purpose. The most promising crop trees in the 4- to 8-inch diameter groups have been pruned. Hardwoods have been removed to release spruce and fir from overhead competition and increase the yield of softwoods. It is planned to begin removing balsam fir of merchantable size, together with spruce of poor quality or low vigor in a series of light selective cuttings during the next five years. Eventually it is expected to develop a many-aged stand yielding a continuous sequence of large-sized crop trees with butt-logs almost entirely free from knots.

As a corollary of this experiment in sawtimber management, a series of partial cuttings varying in intensity from 10 to 60 percent of the basal area were arranged in a commercial timber sale in an even-aged stand of spruce and fir about 65-years-old and about 90 acres in extent. A record was kept of operating costs for each degree of cutting. Just as was the case in the white pine production cost study, so long as there was no road building to be done, costs were not materially affected by the degree of cutting. These findings are significant because commercial operators so frequently cite supposedly higher costs as a barrier to any form of partial cutting. This series of cuttings is also of interest as illustrating the extent to which commercial logging operations may go without detriment to scenic or aesthetic values. In some respects the area was more attractive after the cutting than in its natural state.

Soil Fauna

During the past year studies of the fauna of forest soils in the spruce types were initiated. This is a field about which very little is known so that it is necessary to do considerable exploratory work to develop efficient techniques and to become familiar with the numerous species of mites and other micro-arthropods which constitute the rather prolific population of the forest floor.

Attention is being devoted first to the part soil fauna may play in the reduction of litter and of the deep accumulation of humus which occurs so frequently in the spruce types. Analysis has been made of the fauna in a typical virgin stand as a basis for comparison with the fauna which may be found on cut-over areas and in second growth stands on an old burn both in its original density and after thinning. Several species of mites and fly larvae have been found tunneling out the interiors of spruce needles. The activity of such species may be of considerable importance in creating conditions favorable for the absorption of precipitation. The significance of the soil fauna is further indicated by finding that the black humus layer of the forest floor consists almost entirely of feces, being organic matter which has passed through the digestive tracts of countless generations of animals of the soil and overhead canopy.

Management of Northern Hardwoods

The major effort in the management of northern hardwoods is being directed toward determining the extent to which selective or partial cutting may be substituted for the clear-cutting now in general practice. Early attempts at partial cutting were followed by serious decadence of the residual stand, especially marked in the case of yellow and paper birch. This decadence was found to be attributable only to inability of the trees to adjust themselves to a radical change in environmental conditions. Experimental thinnings removing not over 40 percent of the volume have not been followed by serious deterioration. Relatively light cuttings, therefore, do not dangerously expose the residual stand, but marking must be judiciously handled to avoid loss of yellow birch.

On the Bartlett Experimental Forest an experimental series of selective cuttings have been in progress for five years, one five-acre block of many-aged northern hardwood forest having been treated each year, removing from 24 to 34 percent of the total cubic volume. In an adjacent compartment, a comparable five-acre block was clear-cut in each of the first three years, but additional clear-cutting will not be undertaken until the second cutting cycle on the selection plots, which should be in about fifteen years from the initiation of the series. On the areas where a partial cutting was made, the residual stand is developing satisfactorily while the reproduction shows a response in increased growth. On the clear-cut areas much of the advance reproduction may be killed by exposure in the first two years, but this is promptly replaced by a new crop of seedlings in which yellow birch predominates.

On some of the cut-over areas, the existing hardwood reproduction has been cut back with a brush scythe to determine whether this would result in a new stand of improved form and more rapid growth. The results appear quite satisfactory, especially on the clear-cut area where such a practice would have its best application. Other mowings have been made in stands prior to the time of cutting. This should not only prove more economical, but will provide stimulation to the desirable advance reproduction without interfering with the species which seed in immediately after cutting.

In an effort to combine the advantages of both clear-cutting and partial cutting, another compartment is being handled on a group selection basis. An area of about twenty acres is being worked over each year, removing the stand from 10 to 15 percent of the area in irregular openings varying from 0.1 to 0.7 acre in size. The plan is to make similar cuttings in the stand at intervals of perhaps 15 years.

Experiments with clear-cutting and selective cutting are also under way on the Green Mountain National Forest near Danby, Vermont.

Another important problem in the management of northern hardwoods is the treatment of young stands on cut-over areas. In such stands the more desirable species are often in the minority and are subject to suppression by the less valuable species and weeds. Weeding offers promise of improving the composition of these new stands and of stimulating the growth of the more desirable elements. On the Bartlett Experimental Forest, a series of 17 plots have been established to study the weeding problem in areas cut for fuel wood 4 to 10 years previously. Some of the points which these plots should clarify are: (a) period after logging when weeding will be most effective; (b) amount of freedom desirable for crop trees; (c) best method of accomplishing the weeding; (d) effect of treatment on composition and growth of the stand. The areas recently clear-cut will provide an excellent opportunity for additional weeding studies on areas free from the influence of even a scattered residual stand.

Mensuration

The intelligent application of forestry technic to any forest property is predicated on a management plan based on factual data on growing stock and rate of growth. Inventory of existing stock is simple, but the forecast of changes due to growth is complicated by the interaction of species, age, productive capacity of the land, density of stocking, etc. Furthermore, determination of net growth must consider normal losses from suppression, insects, fungus, windthrow, etc.

The physical effort of extracting, counting, and measuring an increment core is much greater than that of measuring a tree for inventory purposes, and numerous borings are needed to establish growth rates to a reasonable degree of accuracy. Such laborious work, however, has been a regular adjunct to management plan surveys on the national forests, on our experimental forests, and wherever sustained yield management is contemplated.

About two years ago the Station undertook an investigation to determine whether it would not be possible to assemble growth data in a form adaptable to any stand in the northern hardwood region, using criteria such as species, age, site, density, and volume. Growth studies conducted at the request of the Regional Forester for both the Coos-Essex (New Hampshire-Vermont) and Tioga (New York) cooperative marketing projects were planned to permit analysis of the various factors controlling growth.

In this investigation mortality is the most difficult factor to evaluate. It can not now be determined accurately from temporary plots which provide data on all other growth factors. A key of rather limited application for estimating time since death was developed in the course of this study. However, the only completely reliable sources of mortality data are permanent sample plots on which all trees are numbered. There is still need for developing a simple and reliable means of determining time since death or expressing the relation between mortality in a given number of years and the number of standing dead trees.

Studies are also in progress of the yield of northern hardwoods in even-aged second growth stands, of the growth of spruce and fir on cut-over lands, and of the approach of understocked stands of second growth spruce and fir to normal.

Forest Planting

With the large areas which have been abandoned by agriculture in the past and the rapid readjustment of land use still in progress in this region, particularly in New York State, forest planting constitutes a major activity in forestry. Although the Northeast has been engaged in tree planting on a large scale for many years and techniques for successful planting of conifers are fairly well-known, there is real need for more intensive research concerning various aspects of the planting problem. The station work in this field is aimed at (a) increasing success and reducing costs of field planting, (b) methods of establishing mixed plantations of conifers and hardwoods, (c) methods for successful planting of areas of poor drainage and heavy competition, (d) elimination of competition from weed tree growth by poisoning, and (e) tests of promising stock grown from seed of known source. This work is being continued and will be supplemented in 1938 by experiments in methods for successful planting of hybrid poplars on old fields.

Forest Genetics

The forest genetics program has been designed to aid both selective silviculture on the extensive areas of forest land which will never be artificially replanted and the rehabilitation of deforested or poorly stocked land by planting. Progeny tests to determine the heritability of important characteristics of native species and criteria for inherent excellence of individual trees will supply the information needed by the practicing forester for adequate marking of stands for thinning, weeding, and final cutting. The ideal obviously is to leave the inherently excellent stock for reproduction of successive generations and thus to achieve improvement of the stand through mass selection from generation to generation.

Hybridization and breeding are aimed at the creation of improved forest tree types for use in the reforestation of sub-marginal farm lands, deforested areas, or areas which are being taken over by inferior species. This hybridization and breeding work will also supply data on inheritance and the mode of inheritance in forest trees, which can be applied to mass selection in native stands.

The breeding program includes a search for outstanding individuals in the native forests which will be used in intraspecific as well as interspecific breeding. Hybridization between species offers outstanding possibilities in a field as new as forest tree improvement, not only because it is possible to combine the desirable characteristics of different species but because first-generation hybrids are often more vigorous than either of their parents. Since all of the excellent characteristics of a wild individual or of a new hybrid can be immediately maintained by vegetative propagation, the Station has also undertaken research dealing with the stimulation of rooting from cuttings of forest tree species.

Breeding work during the past year has been of a more or less preliminary nature to determine flower behavior, blooming time, and other characteristics of sexual reproduction in native species. Seed from controlled pollinations between species was obtained from maple, birch, oak, magnolia, and pine during 1937. During 1938 breeding work will be undertaken with maple, birch, oak, basswood, magnolia, hickory, and walnut.

In the initiation of a search for excellent individuals of forest trees particular efforts have been made to locate hard maples which produce a high percentage of sugar in their sap. The maple sugar industry is important in the region, and if outstanding hard maple trees are found and can be reproduced from cuttings, such stock will find a ready market throughout New England.

The Northeastern Station is cooperating with the Oxford Paper Company in continuing the genetics research with hybrid poplars started by this corporation in 1924. Many new hybrids are available which offer outstanding possibilities from the standpoint of vigor and of resistance to disease and environmental conditions. The Station has leased the Oxford nursery at Frye, Maine, and has produced approximately 250,000 cuttings of the new poplar hybrids during 1938. The most important problem at present is to test the best of these hybrids in other regions of the United States. This is being accomplished by cooperation with Forest Service and Soil Conservation Service nurseries throughout the country. A total of 58 individual hybrid clones are being tested at 25 nurseries, the number of hybrids sent to any one nursery varying from 15 to 25.

Forest Influences

During the past year the Station has initiated, in collaboration with the Soil Conservation Service and the Bureau of Agricultural Economics, a series of preliminary examinations of watersheds as part of the responsibility of the Department of Agriculture under the Flood Control Act of 1936. These surveys are to determine what measures are necessary for run-off and waterflow retardation and soil erosion prevention. The Director of the Northeastern Station is responsible for the work in New England and the eastern part of New York. Preliminary investigations have been made on the Blackstone River drainage in Massachusetts and Rhode Island and the Merrimack River in New Hampshire. Reports on these watersheds will be completed during the spring of 1938. Work has also been done on certain headwater streams in central New York, for which the Soil Conservation Service is primarily responsible.

The Northeastern Station has no appropriation as yet for research dealing with the influence of forest cover on water supply, streamflow, and erosion. However, advantage is being taken of labor available from the Civilian Conservation Corps and the Works Progress Administration to lay a foundation for such studies by the construction of five weirs for streamflow measurement on the Hopkins Memorial Experimental Forest at Williamstown, Massachusetts, and one on the Chenango Experimental Forest near Norwich, New York.

Forest Protection

Fire

Consideration of forest fire statistics for the Northeastern states for the decade ending in 1935 indicates that material progress has been made in the protection effort. In spite of the fact that the latter part of the decade was relatively unfavorable from a climatic point of view, there has been a marked decrease in the area burned annually and in the average size of fires. Some of the states are already well within the standard of allowable burn set up by the Forest Service. In the light of this improvement in fire experience and of the relative importance of the fire problem in this region, it is not believed that forest fire research merits major emphasis any longer. The situation was discussed fully at a conference with state foresters, their chief forest fire wardens, the Regional Forester, and members of his organization. It was generally agreed that the Station should confine its attention for the coming year chiefly to its study of ecological effects of fire and the determination of standards for the appraisal of fire damage. In addition, a study of the rate of spread of fire, particularly in slash on cut-over areas, was suggested.

During the past year the Station, collaborating with the Regional Forester's office and the administrative agencies concerned, prepared look-out detection plans for the states of Rhode Island and Vermont and for the White Mountain National Forest. The analyses on which these plans were based showed that, while in most cases good judgment had been used in locating towers, greater coverage at little increased maintenance costs could be obtained by a re-alinement of look-out points. In Rhode Island, in fact, the plan recommended will effect a saving of about $2,000 a year in operating cost. Extension of this work to other states in the region is primarily a job for the administrative agencies, since the technique has been satisfactorily developed to meet Northeastern conditions.

The Station also cooperated with the White Mountain National Forest in a preliminary analysis of the economics of fire control planning which resulted in the preparation of a map of the forest in zones of economic productivity. The Station plans to continue to collaborate with the administrative organization on an incidental basis in further development of this project.

Data on burned areas in the northeastern oak region were collected during the past year in order to establish standards of fire damage based on forest type, size of timber, and intensity of burn. The task is proving more complicated than originally contemplated because of significant variations in resistance to fire between specific forest types in the same forest region. Thus, while average loss per acre burned in cordwood stands in the oak region is about 38 percent, losses in individual types vary from 25 percent in the chestnut oak type to 48 percent in the case of the scarlet oak-black oak type. Similarly, sawtimber losses which average 12 percent vary for the types cited from 7 to 25 percent. Before final conclusions can be drawn additional data should be obtained.

Silvicultural Control of the Gypsy Moth

Following the comprehensive discussion of the gypsy moth problem at the Research Council meeting in 1936, the Station maintained a technical forester at the office of Gypsy Moth Control, Bureau of Entomology and Plant Quarantine, at Greenfield, Massachusetts, until reduction of emergency funds necessitated termination of the work in the fall of 1937. This man spent his time with Civilian Conservation Corps control crews working out demonstrations of the application of silvicultural measures to increase the natural resistance of the forest to gypsy moth attack by reducing the proportion of favored food species. Type maps and careful surveys of stand composition and intensity of infestation were made in each area treated, so that the effect of treatment and the progress of infestation can be followed in subsequent years.

In order to train those actually engaged in control operations, especially camp foremen and superintendents, in the application of silvicultural measures, the Station cooperated with the office of Gypsy Moth Control in two field days, the first of which was held at Greenfield, Massachusetts, in June and the second at Westfield, Massachusetts, in September. These meetings were well attended, and the instruction given was well received by the men present. It is apparent, however, that really effective application of silvicultural measures of control on a broad front will only be brought about by the assignment of technical foresters to the permanent staff of the control organization.

To determine the extent to which Massachusetts forests lend themselves to silvicultural control, tallies of about 11,000 survey plots representing 90,000 acres of state forests were analyzed. This showed that, in the Berkshire region west of the Connecticut River, more than three-fourths of the forest area is naturally resistant or could be rendered reasonably safe from defoliation by gypsy moth in a single silvicultural treatment. East of the Connecticut River, however, about half of the forests is so largely composed of favored food species that resistance to gypsy moth attack can only be brought about at great expense by clear-cutting and planting, or over a long period of years by gradual encouragement of resistant species in repeated silvicultural operations. But even in the eastern section of the state, about 38 percent of the forest can be rendered reasonably resistant in a single treatment.

Forest Insects (Bureau of Entomology and Plant Quarantine)

As mentioned in the introductory section, protection of forests from insects and disease becomes of increasing importance as interest in forest management grows and as fire protection becomes more effective. The Northeast is in a particularly vulnerable position with respect to forest pests because of the heavy traffic entering northeastern ports from other countries. Over a long period of years it has been faced with a succession of new pests, some of which threaten very serious damage.

The Bureau of Entomology and Plant Quarantine maintains a forest insect laboratory with a staff of eight technical men at New Haven, Connecticut, in cooperation with the Northeastern Forest Experiment Station. One of the major concerns of the forest insect laboratory at present is the European spruce sawfly which has killed extensive areas of timber in Quebec, Canada, and last year defoliated several thousand acres in northern Maine, and in three localities in New Hampshire and Vermont.

A million and a half cocoon parasites of the European spruce sawfly were obtained from Canada and released in infested areas during 1937. The forest insect laboratory at New Haven is planning to rear about 5 millions of these parasites for release in 1938, a number deemed sufficient for effective colonization in all the areas of known infestation. Plans are under way for study of other parasites to assist in the control of this insect.

The infestations of the fir bark louse and the beech scale also showed a marked increase in 1937. An undetermined native sawfly on red pine has been reported in eastern Massachusetts. This insect can be readily controlled by spraying with arsenate of lead. The larch case-bearer is also being studied. Heavy feeding by this insect for two or three successive years is causing considerable mortality of the larch which, fortunately, is a species of relatively secondary importance.

Salvage operations are in progress in the spruce bark beetle infestation on the Green Mountain National Forest. Copper sulphate treatment has proved a failure in dealing with this insect, but parasites appear to be very common.

The forest tent caterpillar was another active pest during the past year, causing extensive defoliation in stands of northern hardwoods. Its food habits appear to be to a considerable extent similar to the gypsy moth. However, sugar maple, not greatly favored by the gypsy moth, is one of the species most seriously damaged by the forest tent caterpillar. Other species favored by this insect are red oak, aspen, paper birch, cherry, elm, and basswood. Red maple is particularly unfavored as food. White ash and butternut foliage, which develops somewhat later than other deciduous foliage in this region, apparently is unfavorable for the newly-hatched caterpillars, but is favored as food after the leaflets unfold. Foliage of beech, yellow birch, and hickory is apparently not particularly favored by the caterpillars, but the indications are that a small percent will survive when restricted to these species.

Forest Pathology (Cooperation with Bureau of Plant Industry)

The Bureau of Plant Industry also maintains a field office at New Haven, Connecticut, in cooperation with the Northeastern Station. During the past year a study of decay in sprout stands of northern hardwoods has attracted favorable comment. Based on this study tentative recommendations for cultural work, such as is being done by the C.C.C., have been issued. Seedlings or seedling sprouts are of course to be favored when present. Treatment of sprout stands before they are 20 years old is desirable. The principal species are then listed according to their resistance to decay. Unfortunately, red maple which is of value for soil improvement and for increasing resistance to gypsy moth and forest tent caterpillar is most subject to decay and sprouts of this species offer no promise of yielding sawtimber. Wherever possible, crop trees should be selected from sprouts arising from stumps less than 4" in diameter. If sprouts from larger stumps are selected, they should be of low origin and show small stump wounds. Except in the case of pairs or clumps over 20 years of age with high unions, sprout clumps may be safely reduced, selecting for the crop tree the most vigorous single-stemmed individual. In selecting crop stems and cutting sprouts, care should be taken to avoid wounding or opportunity for subsequent friction which may provide an avenue of entrance for decay.

The investigation of nectria cankers had previously resulted in the formulation of a similar set of specific instructions for modification of silviculture to minimize loss from this widespread disease.

Plantation diseases are receiving an increasing amount of attention, several cankers having already received study as potential sources of trouble in pure coniferous plantations approaching a stage of overcrowding. A systematic and recurrent survey of the older plantations in the region is planned to detect disease infections in their early stages. Incidental work on a number of diseases which are already fairly well understood, such as the chestnut blight and the white pine blister, will be continued. Work on the Dutch elm disease is not handled at the New Haven laboratory.

Forest Wildlife Relationships (Bureau of Biological Survey)

With the re-appointment of a biologist to the Northeastern Station early in 1937, major emphasis is being placed on the influences of forest practices on wildlife. The problem of the effect of cuttings of various sorts in different forest types, age, and condition classes upon wildlife is so broad and involved that it must be set up on a long-time basis. The plan is to coordinate the work as far as possible with wildlife programs of the National Forests, the State Conservation Departments, and universities interested in wildlife management. Close contact will be maintained with work being done on the experimental forests of the Northeastern Station. In addition, data accumulated in a region-wide grouse survey by a number of investigators are to be cleared annually through the Station biologist.

RS - NE
M-1

April 1, 1938

Methods of Cutting in Spruce Region

1. Field division: Forest Management.

2. Work project: Silvicultural investigations.

3. Functional project: Silvicultural investigations.

4. Line project: Methods of cutting spruce types.

5. Purpose of work: To determine the best method of regenerating spruce stands in the various spruce types of the region.

6. Review of past work: Broadly speaking, spruce stands may be segregated into two classes:

(1) those of most common occurrence which can be easily regenerated through relatively simple and inexpensive measures;
(2) those less abundant as to area, consisting of:

(a) dense, even-aged stands of immature spruce and fir, and
(b) stands with strong admixture of hardwoods in which regeneration presents a difficult problem.

The technique for successfully regenerating stands falling in the first class has been solved. These usually have an abundance of advance reproduction to work with. Successful management lies mainly in protecting the young growth from logging damage, from subsequent windthrow and fire, and from excessive shading and crowding by hardwoods.

The problem of how to regenerate spruce stands falling in the second classification is less simple. In such stands reproduction is generally absent or deficient. Studies so far indicate that second growth spruce stands should be given a light initial cut removing one-fourth to one-half the stand, permitting the establishment of reproduction under the shelter of the remaining trees. Ten to fifteen years later when reproduction is fully established, the remainder of the stand may be cut. When adequate reproduction of softwoods is not present in stands containing strong admixtures of northern hardwoods, no method of cutting now practicable will, with any certainty, prevent an increased representation of hardwoods in the succeeding stand. Stands in which sugar maple and beech predominate are particularly liable to be unsatisfactorily stocked with spruce and fir reproduction.

Studies of subsequent regeneration of cut-over spruce stands reveal that changed seedbed conditions and dense stands of hardwood sprouts, together with invading brush growth, discourage establishment of spruce and fir following cutting. Where the ground has been broken up and competing vegetation is not too aggressive, the new seedlings may gain a foothold within the first year or two following cutting, but with each passing year conditions become less and less favorable for their establishment.

Studies of slash disposal show that heavy slash aside from the fire hazard it represents forms so dense a cover under certain conditions that it effectually smothers out the advance reproduction beneath it. Slash disposal measures should aim to reduce the density of slash by scattering or burning to the point where it is no longer a deterrent to reproduction. Analysis of slash data shows that rate of slash decay is correlated with age, aspect, elevation, and steepness of slope. It appears that softwood slash may constitute an abnormal fire hazard for eight to twelve years.

7. Accomplishments during past year: Experimental cuttings on a 90-acre tract of second growth spruce removing from 10 to 60 percent of the softwood present, supplemented by analysis of costs of operation, to obtain information on what degree of cutting is most favorable to spruce reproduction, what proportion of the stand can safely be removed without subjecting the residual stand to excessive windthrow, and how partial cutting affects commercial operating costs.

8. Plans for next year: On completion of the pulpwood cutting on the 90-acre tract mentioned above, hardwood cuttings will be superimposed on the treatments applied to various strips to correspond to the percentage removal of spruce and fir. A series of large scale method of cutting plots in a northern hardwood-spruce tract on the Finch-Pruyn Experimental Forest in the Adirondacks will be established. A report on the influence of seedbed conditions on the survival of red spruce and balsam fir seedlings will be prepared in 1938. Numerous permanent sample plots are scheduled for remeasurement this year. Slash disposal studies will be extended to fill gaps in the series of data thus far obtained.

9. Date of completion: A continuing project based largely on permanent sample plots. Progress reports will be prepared from time to time.

10. Assignment: M. Westveld.

RS - NE
M-4

April 1, 1938

Methods of Cutting in Northern Hardwoods

1. Field division: Forest Management.

2. Work project: Silvicultural investigations.

3. Functional project: Silvicultural investigations.

4. Line project: Methods of cutting in northern hardwoods.

5. Purpose of work: To determine the relative merits of clear-cutting, tree selection, and group selection cutting methods in the northern hardwoods type.

6. Review of past work: A five-acre plot in the many-aged northern hardwood type has been selectively cut in each of the past four years, removing about 30 percent of the basal area. Companion plots were clear-cut in three successive years. Group selection cuttings, clearing about one-eighth of the area in small openings, were initiated in 1936. A cutting cycle of about fifteen years is contemplated for these group cuttings. Detailed remeasurements and tallies have been restricted to a check of the reproduction on the clear-cut plots two growing seasons after cutting. At this time the more desirable species were well represented and in spite of the rank growth of pin cherry, it seemed probable that if left undisturbed, the areas would restock to a fair quality stand of hardwoods. Selectively cut areas appear in excellent condition.

7. Accomplishments during past year: During the past year seven additional group selection sample plots were established in the many-aged northern hardwood type. These plots varied from .22 to .45 acres in size and the total area, 2.43 acres, represented a periodic cutting operation on a twenty-acre block.

8. Plans for next year: Five-year remeasurements will be obtained on the first of the series of plots established to study clear and selective methods of cutting. An additional five-acre plot will be added to the tree selection series and another twenty-acre block will be treated by the group selection method.

9. Date of completion: An additional ten years' observation and remeasurement should provide a sound basis for weighing the relative merits of different methods of cutting. The full significance of the project, however, can only be determined after carrying the study through a complete rotation; namely, 120 years.

10. Assignment: Victor S. Jensen.

RS - NE
M-1

April 1, 1938

Stand Improvement in Spruce Region

1. Field division: Forest Management.

2. Work project: Silvicultural investigations.

3. Functional project: Silvicultural investigations.

4. Line project: Stand improvement in spruce types.

5. Purpose of work: To develop measures for increasing the production and growth rate of spruce and improve its quality.

6. Review of past work: Girdling of defective overtopping hardwoods has been shown to be an economical and effective method of increasing the growth rate of spruce, and has been widely adopted as a measure of stand improvement. Thinning of old field spruce stands has also been shown to be a practical measure for increasing annual increment. Experiments in weeding of young spruce stands on cut-over areas and of thinning at later stages are under way. Selective pruning of crop trees to improve the quality of sawtimber yield is also in progress. Elimination of undesirable tree growth from planting sites, plantations, and stands of natural reproduction by poisoning and girdling has been studied. Poisoning, while killing the trees, often fails to prevent subsequent sprouting or root suckering. With aspen girdling without notching is most effective in eliminating root suckers.

7. Accomplishments during past year: An experiment in release cutting in which all hardwoods were removed to release the spruce fir understory was initiated on a 20-acre tract. A two-cut system, designed to open the stand before final cutting to allow advance reproduction to develop, is being undertaken on an adjacent tract.

8. Plans for next year: Studies in girdling, weeding, releasing, pruning, and thinning will be continued. Plans call for the establishment of a series of weeding plots in which pathological phases will receive special attention.

9. Date of completion: No definite date can be fixed for completion. Permanent sample plots form basis for most of these studies. Progress reports will be prepared from time to time.

10. Assignment: M. Westveld.

RS - NE
M-4

April 1, 1938

Stand Improvement in Northern Hardwoods

1. Field division: Forest Management.

2. Work project: Silvicultural investigations.

3. Functional project: Silvicultural investigations.

4. Line project: Stand improvement in northern hardwoods.

5. Purpose of work: To determine the effects and feasibility of thinnings, weedings, and mowings in the development of northern hardwood stands.

6. Review of past work: In a thinning experiment initiated in 1932 involving instrumental records of changes in environmental conditions, some of the yellow birch shows signs of decadence, but the stand as a whole is thrifty and has made twice as much net volume growth as the check area. Other plots afford comparison of two degrees of thinning in an even-aged stand about 60 years old. Weeding experiments involving twenty-one intensive plots indicate that where a sufficient number of potential crop trees are present to justify weeding, best results are obtained if stands are treated before they are 10 years old.

   On recently clear-cut areas mowing, or cutting back of all advance reproduction, is being tried as a means of improving its form and stimulating its growth. It has been found that better results are obtained at lower cost when mowing is done prior to cutting of the original stand. Studies have also been made on relative merits and comparative costs of transporting cordwood from stand improvement cuttings to truck roads by means of portable steel chutes and using horses. Under certain conditions economies in operation can be effected by use of the portable steel chute.

7. Accomplishments during past year: A new set of thinning plots was established in 40-year-old even-aged hardwoods on the Green Mountain National Forest, with thinnings of 18 and 33 percent of volume.

8. Plans for next year: The 5-year remeasurement data on the thinning plots will be analyzed and a report prepared outlining the significant results obtained on plots established primarily to study the decadence of birch following an opening up of the stand. A portion of each of the 1938 group selection plots will be mowed prior to removing the overstory.

9. Date of completion: The primary objectives of the several phases of this project will largely be fulfilled prior to 1948, but many of the plots should be carried for a longer period.

10. Assignment: Victor S. Jensen.

RS - NE
M-3

April 1, 1938

Stand Improvement in White Pine

1. Field division: Forest Management.

2. Work project: Silvicultural investigations.

3. Functional projects: Silvicultural investigations.

4. Line project: Stand improvement in white pine types.

5. Purpose of work: To develop measures for increasing the production and growth rate of white pine and improve its quality.

6. Review of past work: Until the acquisition of the Massabesic Experimental Forest the main basis for this study was a number of permanent plots established by the Forest Service in 1905 and 1906 in white pine stands, and maintained by the Station since its establishment in 1923. Considerable time has been spent in analysis of plot data and in the preparation of progress reports. Acquisition of the Massabesic Forest at Alfred, Maine, provides an excellent opportunity for expanding this project into a major activity.

7. Accomplishments during past year: Activities were restricted to the Massabesic Experimental Forest. Six sample plots totalling 1.37 acres were established in an area undergoing treatment for developing resistance to gypsy moth. The area in question supports a mixture of pine, oak, red maple, and gray birch. Reduction of the proportion of favored food species was handled as a measure of stand improvement, releasing many crowded or overtopped white pines and providing favorable growing space for better-formed oak and maple trees.

8. Plans for next year: Progress reports will be prepared on sample plots established prior to 1930. A program of experimental pruning, thinning, and stand improvement will be worked out for the Massabesic Forest. Work on this project is still in its initial stages. Substantial work can not be undertaken until funds are made available.

9. Date of completion: No definite date can be fixed for completion.

10. Assignment: H. F. Morey.

RS - NE
Pi-1

April 1, 1938

Silvicultural Control of Gypsy Moth

1. Field division: Forest Management.

2. Work project: Silvicultural investigations.

3. Functional project: Silvicultural investigations.

4. Line project: Silvicultural control of gypsy moth.

5. Purpose of work: To work out silvicultural practices reducing the proportion of species favored by the gypsy moth and to determine the extent to which existing forests in the infested area lend themselves to such treatment.

6. Review of past work: Work undertaken in 1936 in cooperation with the office of Gypsy Moth Control, Bureau of Entomology and Plant Quarantine, largely to provide technical background for Civilian Conservation Corps control operations.

7. Accomplishments during 1937: Analysis of data from surveys of Massachusetts State Forests indicates that in the Berkshire highlands west of the Connecticut River valley about 75 percent of the forest area can be rendered relatively safe from defoliation in a single silvicultural operation. In the area east of the Connecticut River, where oak types predominate, about half of the area can only be rendered resistant to gypsy moth by a gradual conversion which will involve a long series of silvicultural treatments or artificial change of composition by planting. Even in this part of the state, however, fairly satisfactory results can be expected in one or two operations on about 40 percent of the area. Experimental treatments were effected on a number of selected areas as the basis for future observations, and two training schools for C.C.C. and state moth control organizations were held. Silvicultural treatment is now receiving much greater emphasis in control operations as a result of this work.

8. Plans for next year: Preparation of report on analysis of Massachusetts state forest surveys with respect to resistance to gypsy moth. No additional field work contemplated. Educational effort will be continued as an incidental activity.

9. Date of completion: 1938, except for follow-up in future years on experimental areas established in 1937.

10. Assignment: C. Edward Behre.

April 1, 1938

Soil Fauna

1. Field division: Forest management.

2. Work project: Silvicultural investigations.

3. Functional project: Silvicultural investigations.

4. Line project: Environmental factors - Soil fauna.

5. Purpose of work: To determine the function of fauna of the forest soil and litter in relation to fertility and percolation, and the influence of fire, cutting, and silvicultural measures upon the population of fauna helpful in soil building.

6. Review of past work: Begun in 1937 after exploratory work in the Southern Appalachians.

7. Accomplishments during past year: In order to determine the normal population of soil fauna, samples from a long-unburned and undisturbed stand with typical deep humus layer in the red spruce-yellow birch type have been analyzed. Both mites and fly larvae were found to be active agents in reducing litter by eating out the interior of spruce needles. Certain species of primitive genera which were thought to be restricted to the South were also found here. However, these litter reducers are probably of little significance in the reduction of the humus layer which appears to present the major problem. Much of the work of the past year has been exploratory in character.

8. Plans for next year: Certain factors affecting sampling procedure will be studied, such as size of sample, effect of time of day on distribution of fauna in different layers, and effect of moss and slash on population of soil fauna. Populations in undisturbed spruce stands where humus reduction has taken place, and in second growth stands before and after thinning will be compared to the normal population in virgin stands where a deep humus layer has accumulated. Exploratory studies aimed at determining what forest type and stand conditions provide a favorable habitat for earthworms will also be undertaken.

9. Date of completion: A continuing project.

10. Assignment: Arthur P. Jacot.

April 1, 1938

Phenology

1. Field division: Forest management.

2. Work project: Silvicultural investigations.

3. Functional project: Silvicultural investigations.

4. Line project: Tree distribution. Phenological observations of forest vegetation in the Northeast.

5. Purpose of work: To obtain observations on the leaving, flowering, and fruiting habits of forest trees, shrubs, and herbaceous vegetation throughout the region, and to correlate such observations with climatic conditions and other natural phenomena such as forest fires, rise and fall of insect activities, increase or decimation of wildlife populations, fruiting and spread of fungi, et cetera.

6. Review of past work:

(a) Since 1930, when this project was initiated, forty individuals and institutions and sixty Civilian Conservation Corps camps have taken observations of the leaving, flowering, and fruiting of selected forest vegetation;

(b) Fairly complete meteorological records are being obtained at the Gale River and Bartlett Experimental Forests and the Cherry Mountain experimental area on the White Mountain National Forest, the Hopkins Memorial Experimental Forest at Williamstown, Massachusetts, the Chenango Experimental Forest at Norwich, New York, and the Massabesic Experimental Forest at Alfred, Maine.

7. Accomplishments during past year: In addition to the regular seasonal observations, a third annual report on prospective crops of various forest trees was issued late in the summer, based on questionnaires sent to all cooperative observers.

8. Plans for next year: Cooperation will be solicited as usual.

The experimental forests maintained by the Station will furnish phenological and meteorological records as in the past.

Region-wide data on periodicity of seed years of important forest trees and upon effects of unusual climatic factors, such as ice storms, severe winters, drought, et cetera, will be compiled.

In connection with the genetics project data on flowering habits are being obtained.

9. Date of completion: Termination of cooperative observations tentatively set for 1940.

10. Assignment: P. W. Stickel.

RS - NE
NE-3

April 1, 1938

Volume Tables for Northern Hardwoods

1. Field division: Forest Management.

2. Work project: Mensuration.

3. Functional project: Mensuration.

4. Line project: Volume tables - Northern hardwoods.

5. Purpose of work: To prepare regionally-applicable volume tables for the important northern hardwood species in terms of customary units of measurement.

6. Review of past work: Tables have been prepared for white ash, sugar maple, paper birch, yellow birch, beech, giving merchantable volume in cubic feet, in board feet by Scribner rule, and in board feet by International $\frac{1}{4}$ inch kerf rule, by diameter and merchantable length. Tables for total volume in cubic feet of stem and branches have been prepared for these same species and for red maple also. Complete measurements have been made of 308 trees for cordwood volume table purposes, and 77.5 cords of hardwoods have been piled repeatedly in various forms to study variations in piling, effect of species and tree size on solid contents of stacked wood, and effect of bucking into shorter lengths on solid contents.

7. Accomplishments during past year: Data were compiled to show the additional volume available when utilization limits are reduced from six inches to four inches in diameter, for correcting existing tables based on a six-inch limit for application under the more intensive utilization. Measurements of several hundred trees cut on a timber sale area were used to check the merchantable volume tables.

8. Plans for next year: Additional checks on the merchantable volume tables will be sought and any desirable corrections incorporated in the tables. Cordwood tables will be extended to include larger diameter classes as data become available.

9. Date of completion: Checking to be continued as material becomes available. Probable date of completion 1939.

10. Assignment: L. H. Reineke.

RS - NE
ME-2

April 1, 1938

Growth and Yield of Spruce and Fir

1. Field division: Forest Management.

2. Work project: Mensuration.

3. Functional project: Mensuration.

4. Line project: Growth and yield of spruce and fir.

5. Purpose of work: To prepare normal yield tables for even-aged, second-growth stands of spruce, pure and in mixture with balsam fir; to determine the approach to normality of understocked stands; to provide a basis for prediction of growth of spruce and fir on cut-over lands; and to prepare tables of growth which will be applicable over the whole spruce region of the Northeast.

6. Review of past work: United States Department of Agriculture Bulletin 142 was published in 1929, giving tables of yield for fully stocked, even-aged, second growth stands of spruce and fir. Twenty-one sample plots are being maintained in New Hampshire and Vermont to check these tables and to provide information on mortality, changes in composition, and the rate at which understocked stands approach normality. Borings on some 1600 trees on 45 temporary plots in Coos County, New Hampshire, and Essex County, Vermont, were made in 1936, and the plots measured for data on density of stocking, site quality, age, composition, etc. Statistical analysis of data gathered from some 400 plots has resulted in the derivation of a mathematical expression of the volume of spruce and fir on cut-over lands as a function of time since cutting, density (as indicated by the relation between number of trees per acre and their average diameter), and composition (as indicated by proportion of the total basal area represented by spruce and fir).

7. Accomplishments during past year: Growth data by species, sites, and age classes provided for the Coos-Essex cooperative sustained yield project.

8. Plans for next year: Complete growth analysis and prepare regional growth tables. Establish additional plots in understocked stands as opportunity presents. Prepare report on study of growth on cut-over areas.

9. Date of completion: Regional growth tables and spruce increment report, 1938. Plot studies indefinite.

10. Assignment: L. H. Reineke and M. Westveld.

April 1, 1938

Growth and Yield of Northern Hardwoods

1. Field division: Forest Management.

2. Work project: Mensuration.

3. Functional project: Mensuration.

4. Line project: Composition, growth, mortality, and yield of northern hardwoods.

5. Purpose of work: To provide the factual information required as to kinds, sizes, and quantities of forest products which will be produced within a given period of time so that forest management can be directed toward maximum value return under sustained yield handling of northern hardwood stands.

6. Review of past work: For study of yield in even-aged, second-growth stands of northern hardwoods, 52 semi-permanent, intensive, and 114 temporary sample plots have been established in Maine, New Hampshire, Vermont, and New York, some of which have been given one remeasurement. The intensive plot measurements include data on form, defect, and merchantability. Records covering thirty years on a number of sample plots are available for analysis of growth and yield. For the prediction of growth, much basic data were accumulated in the intensive survey of the Bartlett Experimental Forest, completed in 1932. These data were augmented by records of some two thousand increment cores from trees on fifty-five plots measured in Coos County, New Hampshire, and Essex County, Vermont, and some 2,900 cores from 73 plots in Tioga County, New York. Hardwood growth measurement was simplified by the design of an increment core examining device, in which the cores are held and shaved off on both sides, giving a thin section readily transmitting light and thus rendering the growth rings quite distinct. No dyes or stains are needed, and the device can be used in the field as readily as the increment borer itself.

7. Accomplishments during past year: A special study of mortality on plots established in 1932 provided data never before available for growth predictions in northern hardwood types. Analysis of all available data was started as a basis for regional growth tables which will eliminate the necessity for intensive growth study in connection with each management plan survey.

8. Plans for next year: Continue maintenance of and establish new plots for study of yield of even-aged stands of northern hardwoods. Complete computations of growth data for regional growth tables. Inaugurate system of following and recording mortality on permanent sample plots, which will insure accurate and complete data on mortality and the disintegration of dead trees.

9. Date of completion: Regional growth tables, 1938. Yield plot studies indefinite.

10. Assignment: L. H. Reineke.

RS - NE
F-1

April 1, 1938

Planting

1. Field division: Forest Management.

2. Work project: Regeneration investigations.

3. Functional project: Forest planting.

4. Line project: Forest planting.

5. Purpose of work: To determine most desirable types of plantings and to devise techniques that will improve plantation survival and growth.

6. Review of past work: Regional survey of plantations conducted in 1931 and 1932. Study of relation of method and depth of planting to survival and growth initiated in 1932. Planting of mixtures of conifers and hardwoods begun in 1933. Floristic study of wet areas carried on in 1935. Routine observations continued through 1937.

7. Accomplishments during past year: No significant results derived during the year.

8. Plans for next year: First priority given to analysis of data on hand. New experiments will include field tests of hybrid poplars, and possibly studies in direct seeding and variability in size of nursery stock. Planting of mixtures and routine observations on established plantings will be continued.

9. Date of completion: Indefinite.

10. Assignment: Ivan H. Sims.

RS - NE
Pf-1

April 1, 1938

Forest Fire Attack

1. Field division: Silvics.

2. Work project: Fire protection.

3. Functional project: Fire protection.

4. Line project: Forest fire attack studies.

5. Purpose of work: To assist administrative organizations in the fields of pre-suppression, detection, and suppression by analyses of forest fire records, and of forest fire lookout systems, studies of rate of spread of fire and testing the efficiency of new materials and equipment under actual burning conditions.

6. Review of past work: Analyses have been made of fire records of Vermont (1911-1926), Maine (1916-1925), New Hampshire (1921-1925), and Connecticut (1921-1925); results of these studies were turned over to the state forestry organizations for publication and administrative use. Experiments were made with calcium chloride and Zenith Fire Dust on grass fires, but neither material proved effective in retarding or extinguishing fires. In 1936 a study of the lookout detection system on the White Mountain National Forest was started.

7. Accomplishments during past year: Analyses of areas visible from potential lookout points for the White Mountain National Forest, and the entire states of Rhode Island and Vermont, led to recommendations for revision of the detection systems in each case. In Rhode Island the study indicated that the 10-tower system now in use can be reduced to a 6-tower system using five of the present locations and establishing one new point, with a prospective saving of over $2000 annually in costs of operation. In Vermont a system of 25 lookouts appears to give the degree of coverage desired. The proposed plan eliminates 2 out of 21 points now occupied, designates 3 more as secondary lookouts, and recommends construction of 6 new towers. The detection analyses for the White Mountain National Forest involved study of 71 individual points and resulted in recommendation of a system consisting of 15 primary and 6 secondary points. In this system there would be only 4 points over 4000 ft. in elevation. Six towers now in operation would be moved or abandoned.

A preliminary study of the economics of fire control planning on the White Mountain National Forest was undertaken and resulted in the preparation of a map zoning the Forest by economic productivity classes; this map will prove useful not only in planning fire control but also in other phases of land management.

8. Plans for next year: Taking advantage of large areas of slash to be burned this year in the clearing of the Quabbin Reservoir Basin in central Massachusetts, studies of rate of spread of fire in slash and on old fields will be undertaken. Technical assistance will be offered to New Hampshire and other states undertaking lookout detection analyses, but the Station is not in position to assume primary responsibility for further work of this sort.

9. Date of completion: Rate of spread studies will probably be conducted in 1939 as well as 1938.

10. Assignment: P. W. Stickel (R. G. Dustin for detection analysis).

RS - NE
Pf-2

April 1, 1938

Study of Weather and Forest Fuel Moisture Relationships

1. Field division: Forest management.

2. Work project: Fire protection.

3. Functional project: Fire protection.

4. Line project: Fire behavior - Study of weather and forest fuel moisture relationships.

5. Purpose of work: To study weather and forest fuel moisture relationships in order to determine the various degrees of fire hazard that are produced by different types of forest fire-weather.

6. Review of past work: The results obtained from fire-weather stations that were maintained from 1926 to 1930 have been published as separate papers. The weather-fuel moisture data have shown that duff moisture content is reliable index to forest fire hazard and that it can be estimated from integrated measurements of relative humidity (or evaporation for either short periods or 24-hour intervals), air temperature, and number of hours since time of last rain. Alinement charts for estimating duff moisture content and degree of hazard from measurements of the above meteorological factors have been prepared for the following cover types: white pine, red spruce-balsam fir at high altitudes and in northern Maine, and mixed red spruce-northern hardwoods.

7. Accomplishments during past year: In order to meet more fully the needs of protective organizations, a fire danger meter has been prepared for the white pine type based upon the previously published alinement charts.

8. Plans for next year: A general report on forest fire danger to be submitted for publication during 1938. Fire danger meters will be prepared for the other forest types for which data are available.

9. Date of completion: 1938.

10. Assignment: P. W. Stickel.

RS - NE
Pf-3

April 1, 1938

Ecological Effects of Forest Fires

1. Field division: Forest Management.

2. Work project: Fire protection.

3. Functional project: Fire protection.

4. Line project: Ecological effects of forest fires.

5. Purpose of work: To study the effect of forest fires upon standing timber, reproduction, and soil as a basis for standardizing methods of appraising forest fire damage, and to furnish basic information pertinent to the reforestation and management of fire damaged areas.

6. Review of past work: The effect of basal wounding by fire is being studied on a series of plots most of which are in the northeastern oak region. The data obtained on these plots indicate that basal wounding is a serious type of fire injury being responsible for considerable delayed mortality and attack by decay-causing organisms. A laboratory study dealing with the question of variation in heat resistance of individual species has indicated that this may be largely associated with certain morphological and anatomical differences in the character of the bark.

7. Accomplishments during past year: For the purpose of obtaining basic data required in the construction of standard regional fire damage appraisal tables, 24 recently burned areas were cruised in the northeastern oak region in Connecticut and New York. Data on mortality and injury to merchantable stands and to reproduction were obtained on 425 temporary plots located in these burns.

8. Plans for next year: Finish the analysis of fire damage appraisal data collected last year in the oak region, and if funds permit, obtain additional data in sawtimber stands because present data are particularly weak in that class of material. Basal wound plots will also be reexamined.

9. Date of completion: Fire damage appraisal tables for the northeastern oak region should be completed by 1939.

10. Assignment: P. W. Stickel.

RS - NE
Genetics

April 1, 1938

Seed Source Studies

1. Field division: Forest Management.

2. Work project: Forest genetics investigations.

3. Functional project: Forest genetics investigations.

4. Line project: Seed source studies.

5. Purpose of work: To select superior strains or varieties of native and exotic species specially adapted to conditions in the Northeastern region.

6. Review of past work: Scattered plantations of Scotch pine from seed collected at Boonville, New York, planted at widely scattered points in New England in 1932 and 1934. Comparative plantings of two strains of Scotch pine, red, and white pine planted in 1924 at Mt. Toby, Massachusetts.

7. Accomplishments during past year: Fifth-year observations indicate that the Boonville Scotch pine will have a large percentage of crooked trees. Seed of red and white pine from Eagle Lake, Ontario, purchased and distributed to state nurseries for propagation and testing.

8. Plans for next year: Analysis of fifth-year measurements on Boonville Scotch pine. Acquisition of white pine seed of known origin from southern extremity of its range.

9. Date of completion: Indefinite.

10. Assignment: Ernst J. Schreiner and I. H. Sims.

RS - NE
Genetics

April 1, 1938

Field Tests - New Hybrid Poplars

1. Field division: Forest Management.

2. Work project: Forest genetics investigations.

3. Functional project: Forest genetics investigations.

4. Line project: Tests of selected hybrids, individuals, or strains.

5. Purpose of work: To determine the practical adaptability of the Oxford hybrid poplars in various parts of the United States.

6. Review of past work: The thousands of hybrids produced by the Oxford Paper Company were taken over by the Northeastern Station during 1937. No previous work by the Station.

7. Accomplishments during past year: The Oxford nursery was leased from the Oxford Paper Company, and it is estimated that between 200,000 and 300,000 cuttings of 58 hybrid clones will be available for nursery tests during 1938.

8. Plans for next year: Cuttings of the best hybrids will be sent to cooperating Forest Service, Soil Conservation Service, and Bureau of Plant Industry nurseries for nursery tests in practically every region of the United States.

9. Date of completion: Preliminary results will be apparent at the end of the first year; final results will be obtained from 10- to 15-year-old field plantations.

10. Assignment: Ernst J. Schreiner.

RS - NE
Genetics

April 1, 1938

Vegetative Propagation of Forest Tree Species

1. Field division: Forest Management.

2. Work project: Forest genetics investigations.

3. Functional project: Forest genetics investigations.

4. Line project: Vegetative propagation by cuttings.

5. Purpose of work: To determine economically feasible methods for propagation of important forest tree species from cuttings.

6. Review of past work: No work at this Station previous to 1937.

7. Accomplishments during past year: Rooting of dormant cuttings of aspen has been increased to 65 percent by treatment with indolebutyric acid. Greenwood cuttings of the white birch have been rooted 50 percent, red maple 60 percent, and yellow birch to a lesser extent. These experiments seem to indicate a possibility for developing economically feasible methods for rooting forest stock from cuttings.

8. Plans for next year: Experiments will be continued with selected aspen hybrids, hard maple, red maple, birch, and pine.

9. Date of completion: It is expected that this work will be completed within 3 to 4 years. It will be discontinued if some other organization undertakes adequate work along these lines.

10. Assignment: Albert G. Snow, Jr.

RS - NE
Genetics

April 1, 1938

Hybridization and Breeding of Forest Trees

1. Field division: Forest Management.

2. Work project: Forest genetics investigations.

3. Functional project: Forest genetics investigations.

4. Line project: Hybridization and breeding of forest trees.

5. Purpose of work: Controlled hybridization between and selective breeding within forest tree species for the production of improved types, and for information on inheritance and the mode of inheritance.

6. Review of past work: No work at this Station previous to 1937.

7. Accomplishments during past year: Hybridization and breeding during 1937 were more or less exploratory in nature. Many controlled pollinations were made and seed of apparently hybrid origin has been obtained from crosses between species of maple, birch, oak, and magnolia. A particularly large quantity of birch seed set to controlled pollination is now in storage.

8. Plans for next year: Hybridization will be attempted between species of oak, maple, birch, hickory, basswood, tulip poplar, and magnolia.

9. Date of completion: Controlled breeding will be continued every year.

10. Assignment: Ernst J. Schreiner, Albert G. Snow, Jr.

RS - NE
Genetics

April 1, 1938

Cytological Investigations

1. Field division: Forest Management.

2. Work project: Forest genetics investigations.

3. Functional project: Forest genetics investigations.

4. Line project: Cytogenetical investigations.

5. Purpose of work: Cytogenetical investigations, fundamental to the understanding of inheritance in forest trees.

6. Review of past work: No work at this Station previous to 1937.

7. Accomplishments during the past year: A series of problems were initiated on chromosome studies and pollen tube penetration technique with forest tree species. Readjustment of budget, resulting in a reduction of the genetics staff, made it necessary to discontinue this research.

8. Plans for next year: It will not be feasible to employ a cytologist this year. Further work will therefore have to be deferred until 1939.

9. Date of completion: Many phases can be completed within two or three years.

10. Assignment: No regular member of the staff now available.

RS - NE
Genetics

April 1, 1938

Inheritance of Percent Sugar in the Sap of the Sugar Maple

1. Field division: Forest Management.

2. Work project: Forest genetics investigations.

3. Functional project: Forest genetics investigations.

4. Line project: Inheritance and mode of inheritance in forest trees.

5. Purpose of work: To determine the possible inheritance and mode of inheritance of percent sugar in the sap of sugar maple.

6. Review of past work: No work at this Station previous to 1937.

7. Accomplishments during past year: Preliminary experiments during 1937 indicate that there may be an inherent difference in the percent sugar of the sap of individual trees.

8. Plans for next year: Tests on a larger number of individual trees to determine variation in percent sugar and the possible mode of inheritance of this characteristic. If outstanding trees are found, they will be used for selective breeding and will be vegetatively propagated as clones.

9. Date of completion: Preliminary data within 2 to 3 years; final results when progeny trees reach tapping size.

10. Assignment: Ernst J. Schreiner and Albert G. Snow, Jr.

RE - NE
Production Costs

April 1, 1938

Selective Logging in Northern White Pine

1. Field division: Forest Products.

2. Work project: Timber harvesting and conversion investigations.

3. Functional project. Timber harvesting and conversion investigations.

4. Line project: Selective logging - sawlogs - northern white pine.

5. Purpose of work: The project was undertaken to study the relative merits of different cutting practices not only as they affected immediate costs and profits, but also from a long-time land management standpoint.

6. Review of past work: This project, initiated in 1934, was carried out in cooperation with the Forest Products Laboratory, which organization was primarily concerned with the production cost phases of the logging and milling operations. Comparative operating costs obtained on these representative studies indicated that partial cutting practices ordinarily added little or nothing to the handling charges for trees of a given size as compared with clear-cutting operations. This fact is highly significant as excessive operating costs are frequently advanced by white pine operators as the sole justification for the usual destructive clear-cutting practice, the other advantages of selective cutting being recognized and appreciated.

7. Accomplishments during past year: Work on the summary report in cooperation with the laboratory.

8. Plans for next year: A summary report for the six operations included in this project will be put out in cooperation with the Forest Products Laboratory.

9. Date of completion: This project is completed aside from periodic remeasurements to be obtained on the cut-over areas.

10. Assignment: Forest Products Laboratory (A. O. Benson) - Victor S. Jensen.

RE - NE
Production Costs

April 1, 1938

Logging in Northern Hardwoods

1. Field division: Forest Products.

2. Work project: Timber harvesting and conversion investigations.

3. Functional project: Timber harvesting and conversion investigations.

4. Line project: Selective logging - sawlogs - northern hardwoods.

5. Purpose of work: This study in the Northeast was primarily an analysis of the production costs and returns on representative northern hardwood logging operations. The cut-over areas will also serve as studies on the development of the residual stands and reproduction following commercial cutting.

6. Review of past work: The bulk of the work on this project which was carried on in cooperation with the Forest Products Laboratory, was completed in 1935-36. Although it was not possible to obtain comparative costs between different methods of cutting operations, an anlysis of the data brought out the extremely wide spread between operating costs and sale values in the case of larger, high quality hardwoods.

7. Accomplishments during past year: Individual reports prepared by the Forest Products Laboratory for each of the three operations included in the project.

8. Plans for next year: -

9. Date of completion: This project is completed aside from periodic remeasurement to be obtained on the cut-over areas.

10. Assignment: Forest Products Laboratory (A. O. Benson) - Victor S. Jensen.

RE - NE
Production Costs

April 1, 1938

Selective Cutting of Spruce and Fir Pulpwood

1. Field division: Forest Products.

2. Work project: Timber harvesting and conversion investigations.

3. Functional project: Timber harvesting and conversion investigations.

4. Line project: Selective logging - pulpwood - spruce and fir.

5. Purpose of work: To study the relative merits of different methods of cutting in second growth spruce and fir stands and the costs of producing pulpwood from trees of different sizes.

6. Review of past work: The 1935 and 1936 field work on this project included detailed cost data from the time the trees were cut until the wood was delivered at the mill; these observations covered a variety of operating methods and different crew organizations. The project was restricted to small operations being conducted by members of the Forest Products Cooperative Association in northern New Hampshire.

7. Accomplishments during past year: Compilation of basic material.

8. Plans for next year: Analysis of the data will be completed and the final report prepared.

9. Date of completion: Aside from the periodic remeasurement of plots established on the cut-over areas, the project will be completed in 1938.

10. Assignment: Victor S. Jensen.

RE - NE
Forest Survey

April 1, 1938

Forest Survey

1. Field division: Forest Management.

2. Work project: Nationwide survey.

3. Functional project: Nationwide survey.

4. Line project: Cooperative technical supervision of an inventory of forest resources in southwestern Maine.

5. Purpose of work: To insure adequacy of field methods in the inventory of the white pine region of southwestern Maine and to determine the most desirable technic for inventorying the entire Northeast.

6. Review of past work: In 1936 twelve enrollees and a foreman at each of four CCC camps in southwestern Maine began an inventory of forest resources in accordance with plans for field and office work prepared by the Northeastern Station. Initial training of field crews was under the supervision of the Station. During the first work period, a total of 26 towns (about 500,000 acres) were covered by the 0.25 percent cruise.

7. Accomplishments during past year: One of the CCC camps was discontinued. The remaining three camps continued the survey with doubled crews. Forty-five towns have been completed (about 900,000 acres).

8. Plans for next year: Survey is to be continued, with crews operating from side camps to reduce travel. Technical supervision by the Station to be continued.

9. Date of completion: 1939.

10. Assignments: L. H. Reineke.

Coöperative Management and Marketing for Farm Woodlands

1. Field division: Forest Economics.

2. Work project: Private forestry investigations.

3. Functional project: Private forestry investigations.

4. Line project: Coöperative management and marketing for farm woodlands.

5. Purpose of work: To establish the technical basis for coöperative management and utilization of farm woodlands in order to rebuild depleted growing stocks, restore and stabilize local forest industries, and afford woodland owners regular and more adequate income.

6. Review of past work: Study of a prospective coöperative unit tributary to Cooperstown, New York, was initiated in 1935. An analysis of land use and forest resources by individual farm units, including character and amount of material which might be obtained in a light selective cutting, was undertaken. About 8,000 acres of forest land have been covered by a 100 percent inventory. A coöperative organization with 280 members has been incorporated. Construction of a processing plant especially designed to handle local material efficiently has been commenced, with a loan of $100,000 from the Farm Security Administration. A study of industrial markets for wood within a radius of 30 miles from Cooperstown discloses the possibilities of handling a variety of products. The use of wooden crates by the fruit and vegetable growers of New York State has also been studied.

7. Accomplishments during past year: Development of a simple and practical system of woodland inventory and control of cut, which greatly reduces the cost of obtaining the technical data for sustained yield forest management. Publication of a bulletin "Centralized Management and Utilization Adapted to Farm Woodlands in the Northeast," based on the Cooperstown situation, has served to clarify thought and stimulate interest in many sections. Assistance to the Otsego Forest Products Coöperative Association, Inc. in obtaining a loan to finance its operations and crystallization of plans for an efficient processing plant. Coöperation with the Forest Products Laboratory and New York State College of Forestry in a study of log rules and log grading for northern hardwoods.

8. Plans for next year: Administration of Government loan to the Otsego Forest Products Association. Continuation of analyses of woodlands of Association members, study of marking practice, and results of logging operations. Study of log scaling, log grades, and recovery values from temporary mill, study of personnel, labor, and other operating problems confronting this pioneer enterprise. Study of labor and stumpage income to members from operations of the Association and its relation to other farm income and rural economy.

9. Date of Completion: Indefinite.

10. Assignment: C. R. Lockard and M. B. Dickerman.

RE - NE
Forest Insurance

April 1, 1938

FOREST INSURANCE STUDY

1. Field division: Economics.

2. Work project: Forest insurance study.

3. Functional project: Forest insurance study.

4. Line project: The basis for forest insurance in the Northeast.

5. Purpose of work: Investigation and promotion of practical methods of insuring forest properties against fire and other hazards.

6. Review of past work: The study has so far been applied only to insurance against loss from fire. Study of the Pacific Coast territory has been completed and the report published. Investigative work has been completed in the Northeast, and the report is in manuscript form.

7. Accomplishments during past year: Final stages of computation and preparation of the manuscript covering the Northeast. Initiation and prosecution of the extension or promotion phase, first in the Pacific Coast territory and later in the Northeast. Cooperation with a committee of stock fire insurance company officers appointed to consider the entry of the companies into this business field. Consultation with executives of a fire insurance company in connection with a proposal for improved fire insurance facilities for pulpwood and other forest products in process of manufacture while still in the woods.

   The promotional work involved conferring with a large number of forest property owners or their agents, chiefly to obtain an indication of potential demand. The result was extremely favorable, the owners expressing strong interest, almost without exception, and indicating their desire for insurance if it can be had at reasonable cost.

8. Plans for next year: Indefinite pending developments of current work and further consideration. The question is whether further study of fire insurance in other territories is preferable to study of other hazards (wind, insects, and other) in the territories already studied.

9. Date of completion: Current promotional phase will be completed early in fiscal year 1939, possibly before end of fiscal year 1938.

10. Assignment: H. B. Shepard.

RI - NE
Surveys
FCS

April 1, 1938

Flood Control Surveys

1. Field division: Flood control surveys.

2. Work project: Flood control surveys.

3. Functional project: Flood control surveys.

4. Line projects: Flood control surveys.

5. Purpose of work: To undertake in cooperation with the Soil Conservation Service and the Bureau of Agricultural Economics preliminary examinations of New York and New England watersheds listed in the Omnibus Flood Control Act of 1936 and subsequent amendments thereto for the purpose of obtaining basic facts by which to determine whether a detailed survey to develop a specific control program from the standpoint of run-off and waterflow retardation and soil erosion prevention in the area is justified.

6. Review of past work: New project started in 1937.

7. Accomplishments during past year: Field examination of flood and soil erosion conditions in Blackstone River (Rhode Island and Massachusetts) and Merrimac River (Massachusetts and New Hampshire) watersheds completed and first draft of report for Blackstone area prepared. Survey made of forest conditions in relation to flood and soil erosion in watersheds of three important tributaries of Susquehanna River, New York.

8. Plans for next year: Preliminary examination reports for Blackstone and Merrimac watersheds to be completed by July 1938. Field work will then be started on Connecticut River watershed and possibly in the Catskill area of the Hudson River watershed.

9. Date of completion: All preliminary survey work and reports to be completed by 1942.

10. Assignment: P. W. Stickel, K. L. Roberts, H. M. Hicks, and D. E. Rulison.

PERSONNEL
Northeastern Forest Experiment Station

Administration	Grade	Title
C. Edward Behre	P-6	Director
Mary E. Turrell	CAF-6	Principal Clerk
Mary C. Weldon	CAF-5	Senior Clerk
Alice K. Swain	CAF-3	Assistant Clerk
Esther S. Moes	CAF-4	Clerk-Stenographer
Julia J. Braun	CAF-3	Assistant Clerk-Stenographer
Catherine A. Heaphy	CAF-3	Assistant Clerk-Stenographer
Grace Moskowitz	CAF-3	Assistant Clerk
Katherine A. Fitzgerald	CAF-3	Assistant Clerk
Helen Wienhusen	CAF-3	Assistant Clerk-Stenographer
Harry Price	CAF-2	Junior Clerk-Stenographer
Lillian M. Antell	CAF-2	Junior Stenographer
Ruth Bick	CAF-2	Junior Clerk
Carlisle Saxton	SP-4	Assistant Engineering Draftsman (Mech.)
Silvics		
M. Westveld	P-5	Senior Silviculturist
L. H. Reineke	P-4	Silviculturist
I. H. Sims	P-4	Silviculturist
V. S. Jenson	P-3	Associate Silviculturist
A. P. Jacot	P-3	Associate Conservationist
H. F. Merey	P-2	Assistant Silviculturist
Genetics		
E. J. Schreiner	P-4	Conservationist
W. K. Starr	P-2	Assistant Conservationist
A. G. Snow, Jr.	P-1	Junior Plant Physiologist
Forest Fire Control		
P. W. Stickel	P-4	Silviculturist
Forest Influences		
P. W. Stickel	P-4	Silviculturist
K. L. Roberts	P-3	Associate Conservationist
H. M. Hicks	P-1	Junior Forester
Donald E. Rulison	P-1	Junior Forester
Forest Economics		
H. B. Shepard	P-5	Senior Forest Economist
C. R. Lockard	P-4	Forest Economist
M. B. Dickerman	P-1	Junior Forester

Publications Issued during 1937

Behre, C. Edward, and C. R. Lockard: Centralized management and utilization adapted to farm woodlands in the Northeast. Published by the Charles Lathrop Pack Foundation and the New York State College of Forestry. February 1937. 67 pp., 9 fig., 10 pls.

Jacot, A. P.: Two unrecorded species of Scutacaridae from the southern Appalachians. Canad. Ent., Vol. 68, pp. 225-229, 3 fig. October 1936.

_____ More primitive moss-mites of North Carolina. Jour. Elisha Mitchell Sci. Soc., Vol. 52, pp. 247-253, 20 pls. December 1936.

_____ Three possible mite vectors of the Dutch elm disease. Ann. Ent. Soc. Am., Vol. 28, pp. 627-635, fig. 13, December 1936.

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_____ Types of forest carpet. Sci. Monthly, Vol. 44, pp. 558-563, 2 fig. June 1937.

_____ Six new mites from western North Carolina. Proc. Ent. Soc. Wash., Vol. 39, pp. 163-166. June 1937.

_____ Evolutionary trends, ecological notes, and terminology of the large-winged mites of North America. Am. Midl. Nat., Vol. 18, p. 631, 10 fig. July 1937.

_____ Journal of North American moss-mites of North Carolina, Jour. New York Ent. Soc., Vol. 45, pp. 353-375, 2 pls. December 1937.

Kraemer, J. H.: Suggestions for silvicultural measures in old field spruce-fir stands in the Northeast. Journal of Forestry, Vol. 35, No. 10, pp. 948-953, 6 fig. October 1937.

Snow, Albert G., Jr.: Progress report on a set of spruce thinning plots established in 1906 in Corbin Park, New Hampshire. Journal of Forestry, Vol. 36, No. 1, pp. 19-25. January 1938.

Stickel, P. W.: Review of Der Lössboden in seiner Beziehung zur Waldvegetation. (The Relation of Loess Soil to Forest Vegetation) by A. F. Kofoedhansen. Acta Societalis Botanicorum Poloniae, 12: 235-256. 1935. Reviewed in Journal of Forestry, Vol. 35, No. 11, pp. 1075-76. 1937.

_____ A glossary of terms used in forest fire control. Mimeographed, 50 pp., November 1, 1937. (Prepared for the Committee on Terminology and Units Used in Forest Fire Research--not available for general distribution).

Westveld, M.: Increasing growth and yield of young spruce pulpwood stands by girdling hardwoods. U. S. Dept. of Agriculture Circular 431. 20 pp., 18 tables, 4 fig. May 1937.

Manuscripts for Departmental Publication, Fiscal Year 1939

Jensen, V. S., and A. O. Benson: A study of logging and milling of northern white pine. Estimated 60 pp., 20 tables, 2 fig. For U. S. Dept. of Agriculture Technical Bulletin.

Shepard, H. B.: Forest fire insurance in the Northeast. Estimated 106 typed pp., 3 fig., 19 tables. For U. S. Dept. of Agriculture Technical Bulletin.

Stickel, P. W.: Forest fire danger in the Northeast: General Discussion of Regional Fire Control, Factors Associated with Fire Danger, and Methods of Measuring Fire Danger. Estimated 50 pp., 10 tables, 15 fig. For U. S. Dept. of Agriculture Technical Bulletin.

Westveld, M.: Effect of seedbed condition on the germination and establishment of reproduction of red spruce and balsam fir. Estimated 16 pp., 8 tables, 4 fig. For the Journal of Agricultural Research.